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Mantis Study Group Newsletter 6

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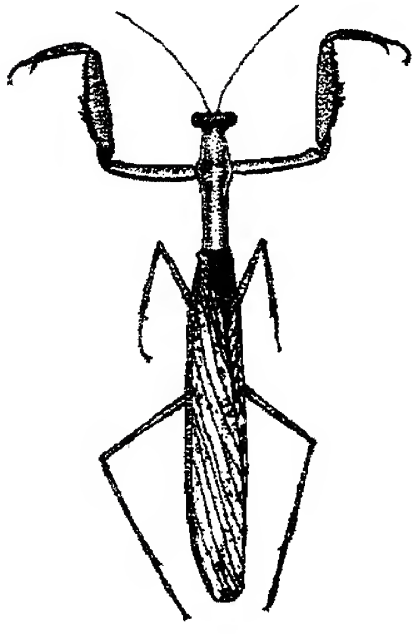


Editorial

In my travels around Borneo I have often wondered about the effect of creating National Parks on insect populations. Certainly one of the best sites that I know of in Sarawak is one which has the added danger of the collector being shot because so many of the locals hunt there at night, and one of the least productive sites for phasmids is one of the established National Parks. Long ago I decided the lack of large insects at Bako National Park was due to the large number of monkeys. I was therefore very interested to come across the abstract of the paper by Cumming *et al.* (page 14) which demonstrates the detrimental effect that the protection of elephants can have on insect populations. Although mantids were not significantly affected in this particular case, there are clearly circumstances where the protection of certain types of wildlife would have a detrimental effect on mantis populations. If anyone knows the address of an organisation dedicated to the extermination of all terrestrial and arboreal vertebrates (except entomologists), please let us know!

Please note that membership fees are now due (£6.50 UK; £7.50 Europe; £9.50 worldwide). There should be a renewal form with this newsletter: please return it as soon as possible. Late returns cause extra work for the membership secretary and extra costs. You will **not** receive any more newsletters if you do not renew your membership. Members in the USA or Canada can pay in their own currency by sending their fees to Helene Meausette (details on the renewal form). We are aware that it is expensive to buy international money orders; Paul Taylor has made arrangements to change banknotes of any currency at very little cost. You may send Paul banknotes in your own currency, but this is done at your own risk i.e. if the money goes missing in the post you will have to pay again.

Before I forget, a quick reminder to everyone: Please write some thing for the newsletter. Articles on disk (PC format, in ASCII or WordPerfect 5.1) are particularly welcome since it saves me having to type them, it also reduces the chance of mistakes! Articles can be e-mailed to me (plxpeb@pln1.life.nottingham.ac.uk), but this address may not remain valid for much longer so check by post or telephone that I have received your e-mail. I check my e-mail about once per month so do not expect a quick reply.

Is it my imagination, or do all the entomology exhibitions come at once? Four in the space of two months seems a lot. Our stand at the AES exhibition on October 4th was very well attended. It was nice to see so many members although we were so busy I did not have much chance to talk to anyone for more than a few seconds! An Entomology Exhibition was held at Sheffield City Museum on 18th & 19th October, this was the first time this event has

been held. Sorry you were not informed about this in advance, the organisers promised to try to let me know sooner next year. The same promise has been made by Derbyshire Entomological Society, their exhibition is on 8th November so you will not receive this newsletter until after the event. Dates of forthcoming exhibitions are as follows:

7th December 1997
Midlands Entomological Fair. Kettering Leisure Village Arena. Note that this is a new venue for this exhibition which was previously held in Leicester. Open 1030-1630.

21st & 22nd March 1998
Yorkshire Aquarist Festival. Doncaster Race Course. We have been invited to exhibit at this exhibition but have not yet accepted because the organisers want us to do both days. I may be able to put on a display on the 21st but I am intending to go to Kettering (see below) on the 22nd. Any member willing to put on a display on one or both days should contact me as soon as possible: Phil Bragg ☎ 0115-9305010.

22nd March 1998
Midlands Entomological Fair. Kettering Leisure Village Arena.

17th May 1998
British Tarantula Society Show. Wood Green High School, Wednesbury, West Midlands. Doors open at 1030. We hope to book a private room and hold a Mantis Study Group meeting at this event. Details will be announced in a later newsletter.

Captive conservation of endangered invertebrates - Conference.

The Federation of Zoological Societies of Great Britain and Ireland are organising a conference to discuss invertebrate culture, conservation and specific recovery projects. The morning session will consist of talks on general topics such as habitats and veterinary aspects; the afternoon session will be short talks which concentrate on specific groups or species. The conference will be held on Saturday March 28th 1998 in the Meeting Rooms of the Zoological Society of London, Regents Park, London, NW1 4RY. Anyone interested in presenting a talk should contact Adrian Durkin at the address below.

Further details can be obtained by sending an sae to: Adrian Durkin, Dudley & West Midlands Zoological Society, 2 The Broadway, Dudley, West Midlands, DY1 4QB.

Forthcoming publication.

The "Bibliography on Mantoptera Literature" by Reinhard Ehrmann will be published in December 1997. Copies will cost about DM60.00. To order, contact: Erich Bauer, Antiquariat Goecke & Evers, Sportplatzwig 5, D-75210 Keltern/Weiler, Germany.

More cheap housing for mantids — Mike Jope.

I find that the tubs in which crickets are sold can provide useful housing for mantids. They build up in quite large numbers and can be used for rearing quite large species. If you staple a paper kitchen towel tightly to the inside of the tub it provides an excellent foothold. I find this especially useful with damaged mantids since it enables them to get a good foothold so they can moult successfully and regenerate their damaged limbs.

Notes on *Phasmomantis sumichrasti* (Saussure) — Mike Jope.

Female 104mm long, slim elongated body, sandy-yellow to light grey, with dark speckling; vestigial winged, with small orange and black hindwings barely covering the thorax. Male 75mm long, very slim and elongated; fully winged. Body dark brown with a green stripe down the side of the wing cases, and white edges to the wing cases. Oothecae small, producing 20-40 large, rather slim, nymphs over an hour or so.

The males and females of this species frequently "threat-display" - spreading their forelegs outwards and upwards to make themselves look larger. The male's display is especially impressive, with him raising his wings to show the brightly coloured hindwings which are reddish with a large black central "eye-spot". This species requires a high humidity to successfully hatch the oothecae; the adults will accept a drink of water whenever offered. Being a slim species, they take comparatively small prey, and the oothecae are small for their size.

Sperm storage in mantids — Phil Bragg.

Most people are probably aware that mantids are capable of storing sperm for long periods and therefore do not need to mate before laying each ootheca. Until recently I, like everyone I have spoken to, believed that one mating was sufficient to fertilize all the eggs laid in a female's lifetime. I now have strong doubts about this.

I tend to keep two or three pairs of adults of *Sphodromantis lineola* and once I have had two or three oothecae hatch I am so busy feeding the nymphs that I either give away the remaining oothecae or put them aside and ignore them unless they hatch. I gradually realised that many of these later oothecae did not hatch. To begin with I assumed this was because they dried out due to neglect. This year I have taken more care with my oothecae yet still found that after the first four or five oothecae from each female had hatched the later ones did not. I cannot rule out the possibility that they dried out or overheated, but it is unlikely that all of them suffered the same fate.

I now suspect that perhaps one mating is only good enough for the first 4-5 oothecae and that another mating is required to ensure that the later oothecae are fertilised. I would be very interested to hear other people's observations. Has anyone noticed anything similar? Has anyone found that all their oothecae do hatch from one mating? Does anyone know of any research that has been done on sperm storage in mantids? Please send in your comments and observations for the next *MSG Newsletter*.

Man eater! — Steven Boutcher

Well not quite, but I have been bitten by a mantis. The perpetrator was an adult male *Sphodromantis gastrica*. It was mid June 1997 and it had begun to warm up outside as hot weather was approaching. The male mantis in question had realised this and was extremely active and was constantly moving around the cage and at night was often flying and doing his best to get out of the cage to find a mate. I watched him for a few nights and observed some quite aggressive behaviour by his habit of going into a defensive posture and turning out his forelegs and violently jolting from side to side just from the sight of me walking my fingers up the side of the cage. He would also capture prey and only eat a very small portion of the victim and then discard the rest of the insect which was usually still alive. I soon came to the decision that I would remove him from the cage and handle him for a while in the hope of quenching his desire to escape.

The very next evening I did remove the male from his cage and placed him on my hand. At first he sat very still on my hand. Then he looked around and seemed to be observing his surroundings. He began washing his forelegs and brushed his eyes and then for some reason he bent down towards my finger and began to run his mouthparts over my skin, this must have been because he had sensed moisture there. What a first felt like a gentle tingling turned into a sharp plier-like pinching sensation. When I looked I saw that the male had actually started trying to eat the skin of my finger and had drawn a small drop of blood! Let me tell you: it hurts much more than a wasp's sting.

I can only conclude that the mantis was only exploring my finger since he never actually grasped and held me in an attacking manner. The mantis died about a week after the incident.

Laying mystery — Robbie & Rory Whytock.

We have an adult female *Popa undata*. She laid her first ootheca about three weeks after being mated. This appeared normal and the mantis seemed fine. A few weeks after that she laid a second one but, to our surprise, this was only about a centimetre square and the female was still quite plump. Later that day she started laying another one but only continued for a couple of minutes, then stopped. She had left us with two small, purple blobs side-by-side and each about 4mm in diameter. We thought this to be unusual but left her until the next morning when we found another three blobs, all very misshapen. There was one which was 1cm in diameter, and two which were about 3mm in diameter. All had been laid on a flat piece of cork bark which is about 30cm x 11cm.

Can someone please explain why this happened?

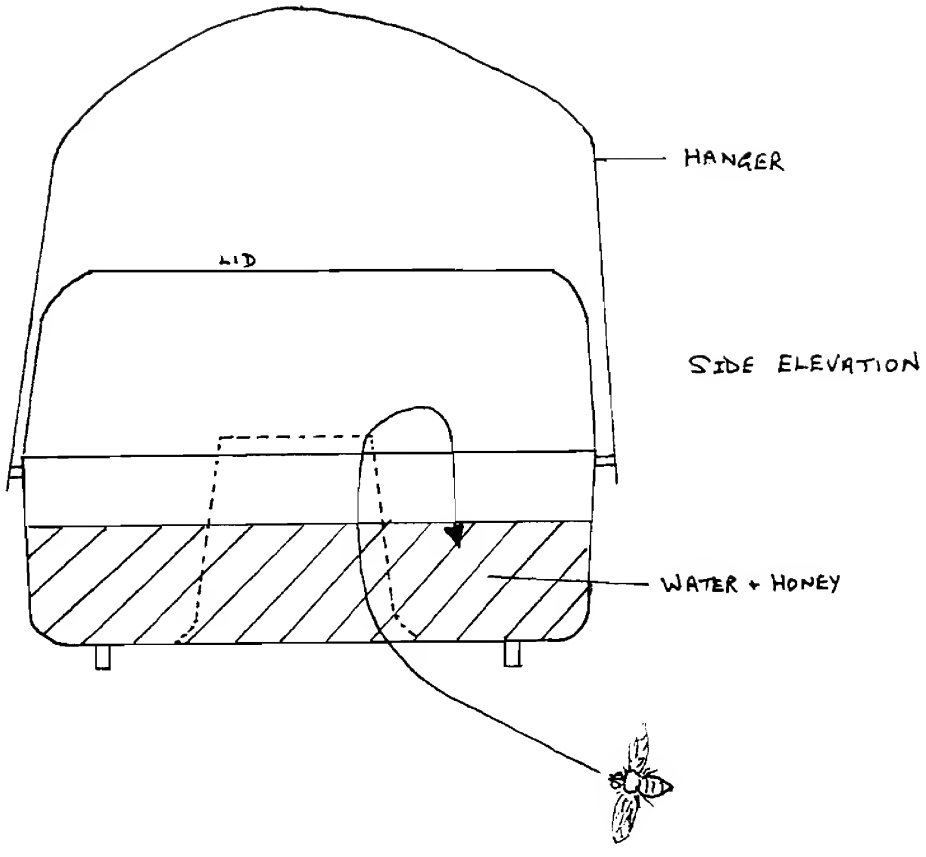
Wasp-traps: useful implements for collecting mantis food — Adrian Price.

While on holiday in north Norfolk in May of this year, I found myself wandering around in one of those "cheap" shops; you know the sort: shops which sell all sorts of articles for a pound or two. Most of their wares are of doubtful quality, but occasionally one finds something of practical use for a little money. So it was on this day when I came across a neat little pile of boxes, each one displaying a cartoon drawing of a wasp on it. I was curious so I purchased one for 99p and, on returning home, assembled it. I partly filled the trap with warm water and added a teaspoon or two of honey.

The next stage in the proceedings was to find somewhere to put the trap in the garden. In one corner of the garden stands a mass of cotoneaster which is often visited by a multitude of insects, especially bees, wasps, and flies, so I decided to hang it there. On the next day I inspected the trap to find not only social wasps (*Vespula vulgaris*, *V. germanica* and *Dolichovespula sylvestris*) but also hoverflies and houseflies, bluebottles, greenbottles etc.

To feed my mantids I take the trap off its hanging point and inspect the contents. At this point there are many dead insects in the trap, but also live ones swimming about. I remove the live ones with long forceps, putting them into a large plastic container (250ml) with a piece of kitchen towel in the bottom. It is surprising how many one can collect in a day.

Then to the mantids! I put the container of flies on the window sill and take off the lid to let one or two flies out. They immediately fly towards the light of the window where I capture them using a thinner container (30ml); I find this size good for administering the fly into the mantis's jar since it allows one to place the fly accurately at the bottom of the mantis's jar and thus affords time to replace the netting or lid to the top of the jar. The



mantis does the rest!

I hope this practice may be of some use to someone, I have certainly found it useful when I do not have time to go out into the field.

General feeding notes and prey suggestions — Steven Boutcher.

In Britain the summer provides an abundance of possible food suitable for mantids and it is at this time of year when you can visit a nearby field or woodland and collect a great variety of live food. I often embark with just my own two hands, a polythene sack and a few plastic tubs. Crickets, common field grasshoppers, moths, bugs, beetles, and caterpillars are just a few of the invertebrate prey which becomes available. Apart from ensuring sound nutrition for the mantis, collected food costs nothing more than a bit of effort.

If you would normally buy livefood like crickets it will save you money. Some people would disagree with collecting live food as it could put considerable pressure on already dwindling species, this however is highly unlikely since large amounts of food need not be collected and wild collecting is only possible during the summer because British winters are far to cold for most insects to be active.

Also, I have heard of carnivorous insects such as mantids becoming infected with native British parasites after being fed collected food. I however have never had this problem and have been collecting live foods in the summer for about 3 years.

Make mine a chocolate-chip muffin — Philip Hinton.

This story stems from a conversation with a colleague, Tim Jenkins, at Stratford Butterfly Farm about rearing newly hatched mantids on cake! "Ludicrous." I thought "Mantids are predators, not cake lovers." but I was soon proved wrong. I have a *Sphodromantis centralis* and one evening, while sitting watching TV and eating a chocolate-chip muffin, the conversation came back to me and I decided to try out the theory on my mantis. Obviously she could not catch the muffin, muffin tends to be a little lifeless, so I placed a piece into her jaws: taken back by this, she lunged at me but then, after another try, she began to eat the piece of muffin. She had soon polished it off and, after finishing, began to clean the last remaining bits off her front legs. "Wow!" I thought, and gave her another piece: not a large one since I thought although she would eat it, I might wake up in the morning and find her dead. She ate it and I left it at that.

The next day at work I told Tim and I do not think he believed me so we took a couple of pieces to the mantids and tried it on them. We first tried a female *Miomantis* sp. and she went wild for it, her antennae waved madly and she was soon tucking in. The next "guinea pig" was a *Deroplatys desiccata* nymph; small and very inquisitive which proved a problem since it was hard to try to make it eat. I must point out that although the mantids eat muffin, they do not choose to, they eat only after the food has been forced to the mouth. Flapjack was tried with *Sphodromantis* sp. which was on display, and with a dead-leaf mantis, both with success. One thing I did notice was that they ate around the nuts in the flapjack for some reason. Back at home I decided to try a piece of melon on my *Sphodromantis* to see if fruit was acceptable. After having it rammed in her face, she started to eat the whole piece which she snatched from my hands. The next day, at work, melon was tried on all the above species with complete success. The melon, muffin and flapjack were all sweet, juicy and soft, just like locust innards (Also sweet? - I do not know), maybe this was the reason they were eaten.

Why did they do this, surely they had not eaten Uncle Sam's Chocolate Chip Muffin before? If anyone has any suggestions as to why this curious phenomenon occurs, please contact me.

The Chinese mantis - *Tenodera aridifolia sinensis* — Tom Larsen.

The following article is based on one which was originally published in the Danish bimonthly magazine for members of Exotiske Insekter and was translated by Thφger Johansen.

The praying mantis *Tenodera aridifolia sinensis* is one of the largest species reared in Denmark at the moment. The female measures 8.5-10cm, and the male 8-9.5cm. As with most of the larger praying mantids, it is quite slim. The wings are generally brownish with a broad green stripe on the leading edge. On green specimens the wings are green with a light green stripe, and between the two shades you can clearly see a thin brown stripe.

The original habitat of the Chinese mantis is Asia and, as the name implies, it has been widely distributed in China. As with its near kin *Tenodera angustipennis* (also from Asia), and also *Mantis religiosa*, it was accidentally introduced to the USA where it was first discovered in 1896. Since then it has managed to gain an extensive foothold there.

The Chinese mantis needs a bit more room than for example *Sphodromantis* spp. since it is far more active than other praying mantids. A container 15cm x 15cm x 25cm is adequate. As far as temperature goes, it thrives well at 23°C and at a relative humidity of 60-65%. It likes to drink often, so remember to spray with water each day, or place a small cup inside the container; this also applies to nymphs.

Whenever Chinese mantids are outside their confinements they have a nasty habit of taking flight when least expected. The males are real air-hogs, and even females are capable of flight (except when they are well fed); the following situation made their flying feats absolutely clear to me. I was busy cleaning up the vivarium and had placed the female somewhere outside her home when, all of a sudden, she took off. Bewildered, the next thing I knew a big green thing was coming towards my face at full speed. It crash-landed on my forehead and pushed its claws into my eyelid, as if to say "What a cool place to sit"; it stayed there until my girlfriend finally managed to ward her off. I had no lasting scars from the incident, but breathed a sigh of relief while she was being removed as many tales of people being attacked and ripped to pieces by wild mantis packs (and what have you) came back to me.

The larger nymphs have a propensity for "breaking" in the middle so that the abdomen hangs down from the thorax; it happens in about 10-15% of the nymphs. It does not seem to bother them much and they normally manage to eat and moult as the others, but as a rule they fade away before adulthood. Speaking of nymphs: pay attention to the last moult as it is extremely space consuming, there has to be a vertical free space of 15-20cm from the top of the vivarium to the bottom. The following experiences demonstrate some of the other problems with rearing this species.

The mating sequence for the first female was quite problem-free, but the male had gone out of his way performing his classic "dance" and abdominal wave to alert the female to his intentions: just as can be seen in *Sphodromantis gastrica*, despite the fact that the Chinese mantis male lacks *gastrica*'s deep-red coloration on the upper side of the abdomen. But even as the female had accepted his invitation, she could not help taking a jab at him when he came within striking range. The male went with the blow and landed on her back: naturally in the reverse position. The instant he touched her back, the female's movements froze and she held her front legs out from her body, a position she maintained throughout the entire encounter. The male slowly turned around and got into the right position for mating. After the mount, she sort of revived from her trance and started to walk about the cage with her passenger on top. The entire mating sequence lasted about six hours and she deposited her first egg-case 15 days later.

The mating of the second female was much more dramatic. The male was more of a macho-type. He probably had a few moments to reconsider his strategy as he felt her jaws working their way through his neck. While the female was busy feasting on Mr Smart-alec, a second male was introduced, he started mating before I had time to close the vivarium. She rewarded me with an egg-case a week later.

The first egg-case hatched at 0600, 35 days after it had been deposited. It contained 143 nymphs, plus whatever the female had devoured before I could intervene. The second female's first egg-case took me by surprise. I had decided to remove her from the premises on day 35 to avoid another case of serial infanticide, but as I approached her cage I realised I was too late again: she sat happily chewing up her offspring by the dozen. It had hatched at around 1700. Clever creeps: I always thought we were supposed to be smarter than them! Well, at least I managed to save 129 nymphs, and I was prepared for the following egg-cases.

As a closing remark, I could commend the Chinese mantis males for actually having an appetite, something quite unlike the males of many other mantis species. The males are usually waiting to be fed and although they will not take fully grown crickets they can easily take medium sized crickets. The females on the other hand are liable to attack any living thing and have been recorded in combat with humming birds and field mice. So do not forget to check your guinea pig or Australian love bird if your Chinese mantis is missing!

Notes on *Tenodera aridifolia sinensis* — Steven Boutcher.

The following notes are based on observations of a female *Tenodera aridifolia sinensis* which were made over a period of six months. She is surprisingly active for her size. She will often spend hours attempting to get out of her cage and is not happy until she has tried twenty times or more, she seems absolutely intent on reaching the highest point of the cage even if this means clutching desperately to the cage roof. I can only conclude that in the wild this species must like to live in very high places such as tall trees or on roof-tops. Although all mantids have superb vision by insect standards, this species displays remarkable eyesight by flying to an outstretched hand in the same way a falcon will fly to a falconer.

This species is usually day-active and it is during the day that they should be fed. Usually whenever prey of suitable size comes within her considerable lunging range she will waste no time before attacking. She is never really bothered how she eats the prey and will eat whatever is nearest her mouth. An adult female will eat at just about any opportunity and they are terrible gluttons, often eating one meal straight after another. They prefer quite hot and reasonably humid conditions. They need to drink and can often be seen drinking condensation from the sides of the cage or from the foliage. She will often spend half-an-hour or more carefully cleaning her legs, eyes and antennae; this is usually done soon after the consumption of a meal.

She does not seem to mind being handled although, due to her natural instincts, she will inevitably try to climb right up your arm. Be careful if your fingers suddenly come into her view as she will sometimes quickly glance and turn her body towards your finger which is of edible size to an adult female, and before you know it, she will have grabbed your finger and will be trying to eat it!

The oothecae are quite large, almost 3.5cm diameter. She can take anything up to four hours to produce a single ootheca, and sometimes longer. Camouflage does not seem to play an important role in her life.

I have noticed some rather strange behaviour in this species. Sometimes, for no apparent reason, they will bite off half an antenna or more commonly their feet! The only explanation I can think of is that the mantis is stressed by the fact that she is confined in a cage, or the cage is too small. To counteract this I would recommend keeping *Tenodera* in a reasonably tall cage.

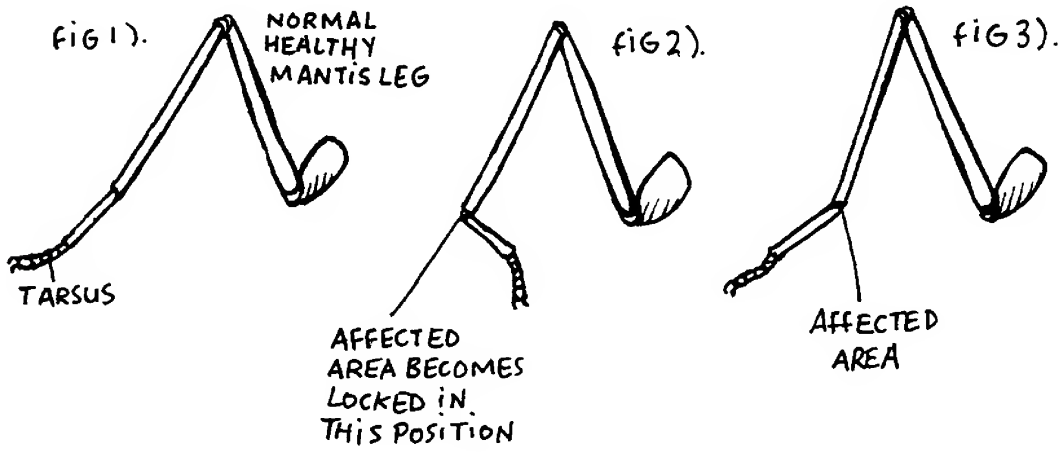
Self-mutilation in mantids and other insects — Phil Bragg.

By coincidence Steve Clark and I had been discussing loss of tarsi in mantids and cockroaches shortly before I read the above article by Steven Boutcher. Steve Clark and I agreed that it occurs in old mantids, not in young adults or nymphs. I have noticed the same loss of tarsi in old cockroaches, particularly in *Gromphadorhina* spp. and other large roaches; I have also noticed it, although rarely, in phasmids of several species. Steve Clark said he had seen a mantis appear to bite off its own tarsus, however it is possible that it just came off when it was being cleaned. Mantids often clean their feet with their mouths and Steve Clark suggested that they get careless when they get older and accidentally bite through the tarsus, alternatively the tarsi may become weak with age. My own view is that it is part of the aging process, perhaps the circulation becomes poor in old insects causing necrosis of the extremities. Certainly the loss of tarsi in old insects occurs in some cockroaches and phasmids which cannot reach their own tarsi to bite them off.

If anyone has any information on this subject, please write in to the newsletter.

Can Praying mantids get Arthritis? — Steven Boutcher.

During my studies I have noticed some strange defects in the leg joints of mantids. So far I have only seen this condition in *Sphodromantis* sp. and *Tenodera aridifolia sinensis*. Figure 1 shows a normal mid leg of a mantis and figures 2 and 3 Show affected legs. It appears that the articulation joint between the tibia and the tarsus becomes locked at an uncomfortable-looking acute angle. I am puzzled as to why this occurs since the mantis seems otherwise perfectly healthy. I should also mention that this condition does seem to become more common with old adult mantids rather than nymphs.



Observations of feeding and the behavioural habits of *Tenodera aridifolia sinensis*, the Chinese Mantis — Steven Boutcher.

Note: The Mantis used in these observations was in no way harmed or at risk of injury during the experiments. I was always present when they were taking place just in case anything started to go wrong.

The *Tenodera aridifolia sinensis* used was very large female, about 10.2cm in length from the head to the tip of the wing and was a fine example of her species. She was being housed in a plastic aquarium which was 12" long 7" wide and 9" high.

Feeding observation 1: The black field cricket *Gryllus* sp.

When I introduced a large 30mm adult cricket, *Gryllus* sp., into her cage the *Tenodera* would usually quickly become aware of the prey and rapidly make her way down from the roof of the lid and towards the cricket. This habit of very obviously stalking her prey could be considered unusual since mantids are more inclined to wait for their prey to come to them or at most stalk the prey for only a few steps. This particular mantis would quite happily chase her prey, within reason, all over her relatively small cage.

Nine times out of ten she would make a successful catch on her first attempt. Being quite large by mantis standards she was obviously quite powerful: so powerful in fact that the initial capture strike would often totally crush the soft body of the cricket and the spines on her forelegs would sometimes pass right through the cricket and out the other side.

I have also noticed that mantids seem to dislike eating the stomachs of crickets. This is probably because most species of cricket are herbivorous or omnivorous and therefore will have a substantial amount of vegetable matter in their diet: mantids being totally carnivorous seem to be able to taste the difference between meat and vegetable and will often eat a

majority of the cricket including the head and legs but will discard the abdomen or at least the stomach and its contents. This is not the case however if the crickets have fed exclusively on meat which species of *Gryllus* and *Acheta* will quite happily do for a short while.

Feeding observation 2: The desert locust *Schistocerca gregaria.*
The small nymphal instars of this large locust species were handled by *Tenodera* relatively easily and treated the same way as adult crickets. However sub-adult or adult locusts were a different story altogether.

A large adult female locust was introduced into the mantid's cage. Unlike the ground dwelling crickets, which would often start running around as soon as they were dropped, the locust soon established itself on a nearby twig and, as expected, remained motionless. This locust was obviously not going to move so I encouraged her to do so by tapping her abdomen with a pair of tweezers, it reacted instinctively by jumping from its perch and landed with a thud on the substrate. The *Tenodera* immediately noticed this sudden movement and turned her head and thorax around to see what all the commotion was about. She promptly realised that the locust was a potential meal and began to make her way down the side of the cage and took a few steps towards the sideways-on locust and then stopped. By now the locust had settled and was sitting very still, perhaps it had detected that it was being stalked? About a minute passed and *Tenodera* had begun to loose interest when the locust made the fatal mistake of raising one of its front legs to wash its antennae. This small movement was enough to initiate a capture response and with lightning speed she lashed out and seized the locust. As in most cases, the initial strike caused severe injury to the locust. Several of the *Tenodera*'s spines on her left foreleg had punctured quite deeply into the locust's thorax, and spines on the right foreleg had pinned its hindleg to its abdomen. The *Tenodera*, with her midlegs and hindlegs firmly rooted on the ground, then displayed and incredible feat of strength by lifting the 8cm locust, which was almost as large as herself, clear of the ground and towards her mouth. She then went to work and quickly began to consume her victim. Surprisingly the locust never really displayed any urgency to escape and did not put up much of a struggle.

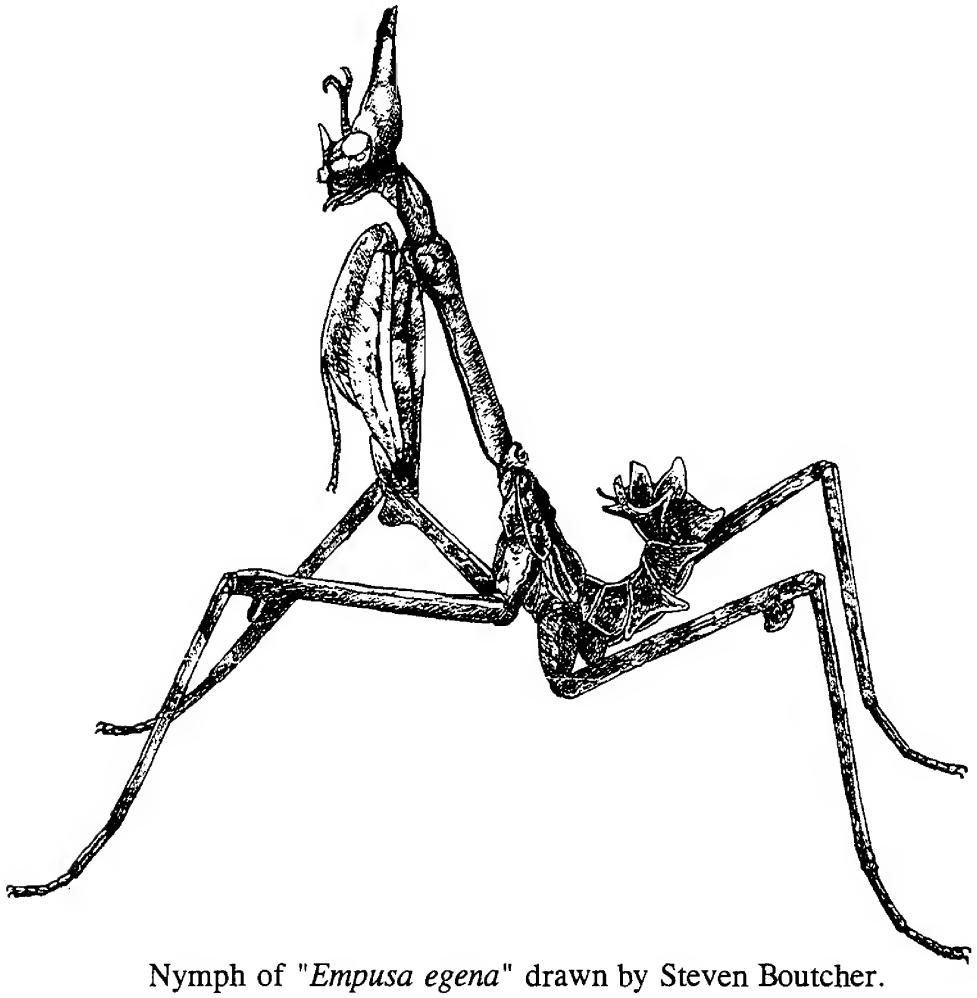
Note: I have known locusts to mutilate mantids with their strong jaws which are designed to cut and chew thin leaves and grass but still have the ability if given the chance to bite, or with their very powerful hind legs which can easily snap a mantis's midleg or hindleg in two, or shatter an eye capsule. Although neither injury will cause instant death since mantids can still function after losing large parts of their body, the damaged area may well become infected which will in turn lead to death. On the other hand, I can say that it is fairly safe to feed your mantis with locust nymphs which are fairly small, about 2nd, 3rd and even 4th instar, since they are themselves rather frail at this young age and are an easy meal for species where the mantids are quite large (65mm+): such as *Tenodera* spp, *Sphodromantis* spp, and *Deroplatys* spp.

A very long wait — Steven Boutcher.

During the summer of 1997 I received a small nymph of *Sphodromantis viridis* from Worldwide Butterflies. The first thing I noticed about this new specimen was its strange mottled grey appearance. Anyway, it grew quite quickly and eventually reached its next moult which would be the sub-adult stage. The next morning I awoke to find that she had moulted and looked perfect: until I saw one of her back legs had unfortunately snapped in the

middle of the femur but was still attached to the rest of the leg. This did not seem to be to much of a problem because she was still able to catch her prey, although her balance was not terribly good. As usual she grew fast and became very fat. Then, on Saturday 6th of August she adopted the upside-down moulting position. "Great" I thought, "Perhaps she will moult either tonight or within the next few days". I could not have been more wrong. For 29 days and nights (that is almost a month!) she remained somewhat morbid and very rarely moved even a few centimetres. She refused to eat during this entire period and would lean away from any food offered. Then one morning I looked and found that she had moulted into a **massive** adult female. She was not especially long but she was extremely stocky and much heavier built than my large *Tenodera aridifolia sinensis*. Unfortunately, she had not managed to repair her snapped femur and it was still awkwardly broken. Her wings too had not expanded properly and they were deformed and wrinkled. My reason for writing this article is that I am amazed by how long the mantis was able to survive without any food and by the strange length of time it took for her to moult.

Comment on the above — Phil Bragg. I have recently had a similar experience with *S. viridis*, last night a female became adult after at least 28 days without feeding, I have four other penultimate instar nymphs which have not eaten for a similar period.



Nymph of "*Empusa egena*" drawn by Steven Boutcher.

The auditory bicyclops: mantids with two ears — David Yager.

We have seen in the previous articles that most, but not all, mantids have a single ear located on the ventral side of the body between the third pair of legs: they are auditory cyclops. Beyond its unique anatomy, the defining features of this auditory system are: it hears only ultrasound; it is tone deaf (can not distinguish between different frequencies); it has about average sensitivity (40-60dB SPL) for an insect; it cannot tell what direction a sound is coming from. The fossil record of mantis evolution is terrible (fewer than two dozen fossils, mostly of wing pieces), so we do not know when the ear first appeared in the mantis lineage. However, we can reasonably hypothesize from comparative studies that the earliest mantids were earless, and that long after the innovation of the ear, several groups, scattered throughout the suborder, returned to an earless state, either totally or with the deaf females of auditory sexual dimorphism.

That is hardly the end of the story. In fact, one subfamily, the Hymenopodinae, has taken mantis audiology to realms where no animal has gone before. They are auditory bicyclops.

The Hymenopodinae are among the most colourful of all mantids. They are small to medium-sized animals that are relatively common throughout sub-Saharan Africa and across southern and southeastern Asia. The most famous member of the group is the truly astonishing "orchid mantis", *Hymenopus coronatus* from Southeast Asia. In South Africa, some of the species are called "target mantids" because of the large bull's eye-like eyespot on the forewings. A few anecdotal reports say that some hymenopodines specialize in ambushing prey from flowers and may have a particular taste for butterflies. However, we know basically nothing about the natural history of these remarkable creatures.

We have recently learned quite a bit about their auditory system, however. They have an ear in the metathorax that matches perfectly the description I gave above. Their ultrasonic hearing (30-50kHz) does tend to be a little more sensitive than the average mantis. We were more than surprised, however, when we saw their complete audiogram. In addition to their ultrasonic hearing, these mantids are equally sensitive to frequencies that we can hear, from 2 to 4kHz. They are largely deaf in the intermediate range (10-20kHz). Hymenopodines have the same directional hearing capabilities at high and low frequencies: none at all.

We once again pulled out our jumbo jar of Vaseline and embarked on an ear hunt. As before, judicious applications of sound-deadening goo combined with recording from the central nervous system showed that the slit between the metathoracic legs was both necessary and sufficient for ultrasonic hearing: no surprise there. These experiments just as clearly showed that the metathoracic ear had nothing whatsoever to do with the 2-4kHz hearing, so we were not dealing with a single auditory system that can handle multiple frequency ranges. Instead, these mantids have a second ear that hears 2-4kHz sounds, but has nothing to do with ultrasonic hearing. The Vaseline studies located a single, low frequency ear in a large, broad groove in the ventral midline between the second pair of legs. Thus, hymenopodines are two-eared animals, but certainly not in any usual sense. Since they have two cyclopean ears, we call them "auditory bicyclops".

It is important to distinguish between two ears that are both part of a single auditory system and two separate auditory systems. In the first case the two ears would work together. We have a growing body of evidence suggesting that this is not the case in hymenopodines. For instance, we can find no neural connections between the two auditory systems: auditory nerve cells from the mesothorax do not connect with auditory neurons in the metathorax and vice versa. We have not yet been able to study what is happening in the

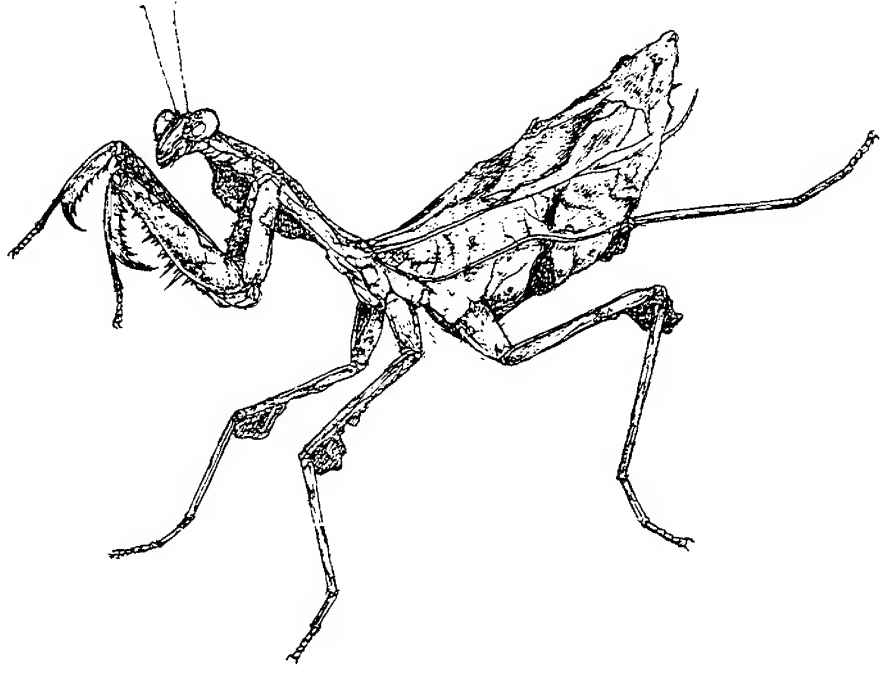
brain, however (it is worth noting here that the insect brain is far less important in directing behaviour than the vertebrate brain; headless insects perform a large number of behaviours quite competently). Even more compelling is that the two auditory systems trigger entirely different behaviours: but more of that next time.

Insects are built of repeating body segments so that, for instance, the mesothorax and metathorax are constructed of the same parts arranged in the same way; this is called serial homology. The two ears of hymenopodines fit this pattern very well. Though they look somewhat different, they are built of the same components and have fundamentally the same structure. The nerve cells that carry information to the central nervous system and even the auditory nerve cells in the central nervous system are serial homologs. This has profound implications for how an auditory system evolves: in a very real sense, these mantids did not evolve two ears, but, rather, evolved the same ear twice.

Most animals that hear, including insects, have two ears on the sides of the body, in the same body segment. Because they are widely separated, the ears allow the single auditory system to determine where a sound is coming from. Frequency discrimination arises from specializations of structure within the ear. The two-eared hymenopodine mantids have not acquired directional hearing, but they certainly have found a unique solution to the problem of tone deafness: if you need to hear a new range of frequencies, just grow a new ear!

Next time: How do mantids use their ears? One function is to help them escape vicious and voracious nocturnal predators.

[Flash!! We have just obtained audiograms from *Hestiasula* and *Phyllocrania*, two genera from the hymenopodid subfamily Acromantinae. Since they both showed the bicyclopean pattern, this is clearly more widespread in the Hymenopodidae than we originally thought. Does anyone have species from the Oxypilinae that we could try?]



Adult female *Deroplatys desiccata* drawn by Steven Boutcher.

Book review

Lauernde Gefahr - Das Leben der Gottesanbeterinnen by Jürgen Hevers & Eckehard Liske (1991) Published by Staatliches Naturhistorisches Museum Braunschweig. Softback, 244mm x 170mm, 64 pages. ISBN 3-925538-04-6. **Reviewed by Phil Bragg.**

The following book has just been brought to my attention. Although published some years ago, there are so few books available on mantids that I thought it worth giving some details about the book; I do not know if it is still available. Unfortunately my German is very limited so I am unable do a proper review. I hope the following information will be of interest.

An excellently illustrated book covering the ecology, morphology, behaviour, and development of mantids. Coloured drawing on front cover, colour photograph on rear cover, 39 black-and-white photographs, numerous black-and-white drawings; most of the photographs are by Reinhard Ehrmann.

Mantis abstracts

The following are abstracts from papers published recently. The papers are in English unless otherwise indicated. The editor would be grateful for copies of any recently published papers so that abstracts may be included in this section of the newsletters.

Bakthavatsalam, N. (1997) *Podagrion* sp. (Hymenoptera: Torymidae), an egg parasitoid of mantids in Nagaland. *Journal of Biological Control*, **9**(2): 130.

The eggs of *Tenodera aridifolia sinensis* (Saussure) were parasitised by *Podagrion* sp. in Nagaland. The percentage of oothecae parasitised was 28 and 40.6 during 1987 and 1988 respectively.

Cumming, D.H.M., Fenton, M.B., Rautenbach, I.L., Taylor, R.D., Cumming, G.S., Cumming, M.S., Dunlop, J.M., Ford, A.G., Hovorka, M.D., Johnston, D.S., Kalcounis, M., Mahlangu, Z. & Portfors, C.V.R. (1997) Elephants, woodlands and biodiversity in southern Africa. *South African Journal of Science*, **93**(5): 231-236.

When elephant densities exceed approximately 0.5km^{-2}, savanna woodlands are generally converted to shrublands or grasslands. The impact of such elephant-mediated habitat change on biodiversity in African game reserves has seldom been measured. We examined species richness of woody plants, birds, bats, mantises and ants in reserves where elephants had destroyed the miombo woodland and in adjacent but intact miombo woodlands outside the reserves. Species richness of woodland birds and ants was significantly lower where elephants had removed the tree canopy. Our findings may have important policy implications for conserving biodiversity in many African reserves in the face of rapidly growing elephant populations (approximately 5% per annum). The problem is further compounded by international public pressures against reducing elephant densities within game reserves while, outside these protected areas, savanna woodlands and their associated faunas are being lost to agriculture. Where then will refugia for habitat-sensitive species exist if not within the region's largest protected areas?

Dusse, K. & Hurd, L.E. (1997) Food limitation reduces body length in mantid nymphs, *Tenodera sinensis* Saussure (Mantodea: Mantidae): Implications for fitness. *Proceedings of the Entomological Society of Washington*, **99**(3): 490-493.

Growth rate and body size have been linked to fitness in the mantis, *Tenodera sinensis* Saussure. We asked how early in the life cycle food level could affect these two parameters. Two laboratory cohorts were offered prey at either high or low density during first and second stadia. These nymphs exhibited significant differences in predation rate, growth rate, and body size, but not in gross growth efficiency. Well-fed nymphs achieved larger body size in a shorter time than poorly fed ones during both their first and second stadia. Because body size of adult females determines maximum fecundity, this response suggests that food level during the early life history of this species can directly affect fitness. Flexibility in body size and rate of development may play an important role in determining distribution and regional persistence of this species in temperate habitats.

Ehrmann R. (1996) Die Mantodea-Fauna von Ågypten. *Entomologische Zeitschrift*, **106**(10): 410-424. [In German]

The 46 Mantodea species known from Egypt are listed. The female of *Severinia ullrichi* n.sp. is described and illustrated in this paper.

Ehrmann R. (1997) Systematik der Ordnung Mantoptera (Mantodea) (Insecta: Dictyoptera). *Arthropoda*, **5**(2): 6-12. [In German]

Within the system of insects the orders Blattoptera and their relatives Mantoptera are placed in the supraorder Dictyoptera. Actually in the Mantoptera we have 438 genera described, with 2310 species. The number of subfamilies, tribes, genera, and species within each family are given.

Fagan, W.F. (1997) Introducing a "boundary-flux" approach to quantifying insect diffusion rates. *Ecology (Washington)*, **78**(2): 579-587.

Dispersal behaviours of organisms have been the subject of extensive ecological investigation at both the theoretical and experimental levels. One common framework for field studies of dispersal behaviour that can be easily melded with theoretical work is the calculation of "diffusion rates." Traditionally, this approach to studying dispersal has required (1) the tedious location of large numbers of individuals at a particular time or (2) actively tracking the movements of individuals. Here, I present a flux-based or "boundary-oriented" methodology that quantifies the passage of individuals into an absorbing boundary of known location at multiple points in time. This approach, which is the natural complement of existing methods, may make quantification of dispersal behaviour more practical for time-strapped field researchers. Under the umbrella of the flux-based approach presented here, I use data from field experiments to determine the effect of initial density on dispersal rate for two sympatric species of praying mantids, species of generalist arthropod predators common in early successional fields. Unlike existing techniques, the methodology I outline here is specifically designed to handle dispersal data recorded from the two-dimensional, "plot-oriented" world of terrestrial ecology, facilitating the measurement of species-specific dispersal parameters that are necessary for meshing several important aspects of theoretical and experimental ecology.

Grimaldi, D. (1997) A fossil mantis (Insecta: Mantodea) in Cretaceous amber of New Jersey, with comments on the early history of the Dictyoptera. *American Museum Novitates*, **3204**: 1-11.

The nymph of a new genus and species of mantis, *Jersimantis luzzi*, is described, in amber from the mid-Cretaceous (Turonian) of central New Jersey. It is the oldest mantis from North America and only the second report for Mesozoic mantids. Although it cannot be definitively placed into a modern family, it is plesiomorphic compared to most modern mantids in the head and pronotal shape, and structure of the raptorial forelegs, similar to what is found in the most primitive extent family of mantids, the Chaeteessidae. The age and apparent phylogenetic position of *Jersimantis* are consistent with the view of a late Mesozoic radiation of the Dictyoptera, not a Palaeozoic radiation as has sometimes been suggested. It is hypothesized that the Isoptera and Mantodea are closely related to the "ovipositorless" roaches that first appear in the early Cretaceous/late Jurassic (into the present) and that the Mesozoic and Palaeozoic roaches with ovipositors represent a paraphyletic assemblage.

Idowu, A.B. (1997) The defensive mechanisms of *Zonocerus variegatus* (L.) (Orthoptera Pyrogomorphidae) against potential predators. *Journal of African Zoology*, **111**(3): 199-203.

Experiments were carried out to determine the role of the repellent gland of adult and juvenile *Zonocerus variegatus* protecting it against vertebrate and invertebrate predators found in the grasshopper's habitat. When approached, the later instars of *Zonocerus variegatus* eject a repellent secretion in the form of a jet-like spray from the abdominal region of the body. The secretion has a penetrating and disagreeable odour which can even be perceived by human beings from a distance of several centimetres. Praying mantids were not affected, but ants and lizard were repelled by the secretion. It is suggested that the rejection and avoidance of the grasshopper by these latter predators is probably due to the unpleasant odour of the insect. The experiments indicate that the grasshopper invests mare in the repulsiveness of the secretion than on its toxicity.

La Greca, M. & Lombardo, F. (1997) A new species of *Pseudacanthops* Saussure 1870 from Bolivia (Insecta: Mantodea). *Tropical Zoology*, **10**(1): 49-55.

The authors describe a new species of *Pseudacanthops* Saussure 1870 (*P. lobipes* n.sp.) from Bolivia characterized by the presence of a lobe at the centre of the medial and posterior tibiae. It appears related to *P. spinulosa* Saussure 1870, from which it differs in the shape of vertex fastigium, in the stronger pronotum metazone, in the shape of its urosternal lateral lobes, in the copulatory apparatus.

Milledge, G.A. (1997) Revision of the tribe Archimantini (Mantodea: Mantidae: Mantinae). *Memoirs of the Museum of Victoria*, **56**(1): 1-63.

The Australo-Papuan tribe Archimantini is redefined. The genera *Pseudomantis* Saussure and *Rhadomantis* Giglio-Tos are excluded. The genus *Austromantis* Sjöstedt is recognised as valid and included. One new genus, *Corthylomantis*, and four new species, *Archimantis gracilis*, *A. vittata*, *Austovates papua* and *Corthylomantis baldersoni*, are described. *Archimantis minor* Giglio-Tos is an new synonym of *A. albomarginata* Sjöstedt, and *Coenomantis melanoptera* (Tindale) a new synonym of *C. kraussiana* (Saussure). *Archimantis inermis* Werner is transferred to the neotropical genus *Angela* Serville. The subspecies *Archimantis latistyla gigantea* Beier is rejected as invalid. Keys to genera and species are provided. Information on biology is recorded, distributions given and relationships discussed. The paper includes 174 illustrations and distribution maps.